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Approved For Release 2003/04/17 : CIA-RDP78B05171A000800060047-5

25X1

June 20, 1969

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Gentlemen:

In accordance with our recent discussions, [redacted] is pleased to confirm our agreement to place a cost ceiling on this project. The cost ceiling will be placed at a total cost of [redacted]. The increase in total contract cost is [redacted]. This increase reflects our latest estimate of cost to complete dated May 23, 1969, with adjustments to provide for new overhead rates and the addition of [redacted] which has been spent in excess of allocated funding.

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Your amendment to incorporate this arrangement should include provision for allowing charges which were accumulated during the period of April 25 through May 16, 1969.

As also discussed, [redacted] cannot accept a cost ceiling without some re-definition of the specifications. The specifications as they now exist are completely adequate for a cost type contract, however there are too many subject areas which would have to be further defined if the specifications were to be amended to be compatible with a cost ceiling. As was mutually agreed in our discussions, the specifications could not easily be revised in detail to serve our mutual purposes.

In lieu of the detailed modification to the specification, we request that the following paragraph will be incorporated in the contract:

Group 1
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downgrading and
declassification

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June 20, 1969

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[redacted] will work within the guidelines of the development objectives. The use of the term "development objectives" should be defined to mean that the specifications to which that term relates are not firm requirements of the contract but are specifications which [redacted]

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[redacted] will attempt to achieve. Any failure on [redacted] part to achieve those specifications will not constitute grounds for either rejection of the item or default under the contract.

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I hope this information will be of assistance to you. If you have any further questions, please contact the writer directly.

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[redacted]
New Program Planning
Photogrammetric & Military Systems

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June 4, 1969

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Subject: Advanced Stereo Rhomboid
Reference: Contract [REDACTED]
[REDACTED]

Gentlemen:

The proposed options for additional work on the Advanced Stereo Rhomboid have been evaluated in an attempt to relate "probabilities of success" factors. For the purpose of this effort, "success" is defined as satisfying the explicit and implied intent of the current development objectives. It is difficult to define all of the parameters necessary for "success" as some aspects are quite subjective. I do believe, however, that our interpretations of the requirements, at this time, are in agreement.

On this basis, we are assigning an 80% probability of success to Option "A". If a redesign of the objectives is undertaken in Option B-1, there is a 50/50% probability of improving the calculated performance. If, based on success in Option B-1, it is decided to proceed with Option B-2, the overall probability is increased from 80% to 85%-90%.

As discussed in our telephone conversation on June 2, the distinction between Options B-1 and B-2 is solely in the fabrication costs of objectives to a new design.

Option A covers all of the effort defined (including fabrication of objectives to the existing design).

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June 4, 1969

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Option B-1 includes all of Option A, plus redesign of the objectives. However, the costs submitted assume only limited success with the optical redesign and therefore would not recommend proceeding with Option B-2. Under these conditions, Option A (including fabrication of objectives to the current design) would be completed.

Option B-2 includes all of Option B-1 (excluding the fabrication of objectives to the current design). The costs submitted for Option B-2 assumes success in optical redesign and therefore provides for fabrication of the redesigned objectives.

If you have any further questions on this project, please contact the writer directly.

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Group 1

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May 28, 1969

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ATTENTION:

SUBJECT: Advanced Stereo Rhomboid

REFERENCE: Contract

Enclosed, please find three(3) copies of [redacted] Proposal #7-114BC for Modification of Advanced Stereo Rhomboid. Cost data, submitted with my letter of May 23, applies to the options listed in this proposal.

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The schedule for Alternate "A" is estimated at four(4) months after receipt of your authorization to proceed. The Optical Design Effort described in Option "B" is scheduled for completion and submittal of a design report within 30 days. The balance of the effort in Option "B" is estimated at four(4) months after your review and authorization to proceed. This four(4) month schedule for completion of Option "B" applies for manufacture of objectives to either the existing design or to a new design.

If you have any questions concerning this proposal, please contact the writer directly.

Yours very truly,

Program Administrator
Photogrammetric & Military Systems

GJJ:em

cc [redacted]
Enc. Proposal [redacted] 7-1148C

Proposal to Modify
The Prototype
ADVANCED STEREO RHOMBOID

Contract Number

25X1

Prepared by:

25X1

May 1969

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1.0

INTRODUCTION

25X1 [REDACTED] has designed and manufactured
25X1 a prototype Advanced Stereo Rhomboid on U. S. Government
Contract Number [REDACTED] This prototype has
been assembled and several iterations of alignment have
been performed. The instrument in its present form does
not fully meet the intent of the original specifications.
It has therefore been concluded that some redesign and
parts remanufacture is necessary before an acceptable
instrument will be available for evaluation.

This proposal contains an analysis of defects in the present
instrument, and describes a series of changes necessary
to upgrade the instrument to meet the intent of the
original specifications. To perform the required changes
additional funds and an extension of delivery are requested.

2.0 SUMMARY OF PROJECT

2.1 History

Phase I of this project, Optical and Mechanical Design, began on 20 November 1967 and was concluded with the delivery of a Phase I report on 19 July 1968. A prime factor in the design of this instrument was to provide the ability to manufacture the unit economically in production quantities. Consequently, the design was conceived with this as an important parameter. The prototype was manufactured with the intent that it would be representative of production instruments.

Phase II, Prototype manufacture, started on 16 August 1968 with a scheduled delivery of 15 March 1969. All mechanical parts and optics were available in January 1969 and the instrument was assembled. The instrument was aligned, following the alignment procedure, during February 1969 and found to be unsatisfactory. The desired resolution goal at the high portion of the Zoom range was not achieved and excessive flare around the bars on a negative resolution target was evident. Effort expended during March and April 1969 to improve the above deficiencies met with only partial success. However, this effort did identify the areas where redesign and remanufacture are necessary.

2.2 Present Status

The prototype instrument is assembled complete with 2X objectives and was examined by the customer on May 8, 1969.

In its present form the prototype instrument is aligned to a compromise solution. The image runout and phoria are not quite satisfactory. One 2X lens [REDACTED]

[REDACTED] is significantly better and will resolve 456 lines/mm (the block of a sixth-root-of-two resolution target nearest the design goal of 480 lines/mm resolution) when installed on the right side of the instrument. The other lens

[REDACTED] is improved with respect to flare, but will not resolve the 456 lines/mm block.

The 1X and 3X objectives are not assembled at this time as non-conformance curves on the lenses were discovered in each of the objectives. As of May 7, 1969 all work on the project has stopped.

Work that would normally be completed, include evaluation and testing, preparation of a reference manual and a final report, final cleaning and other preparations of the instrument for delivery, had not been performed.

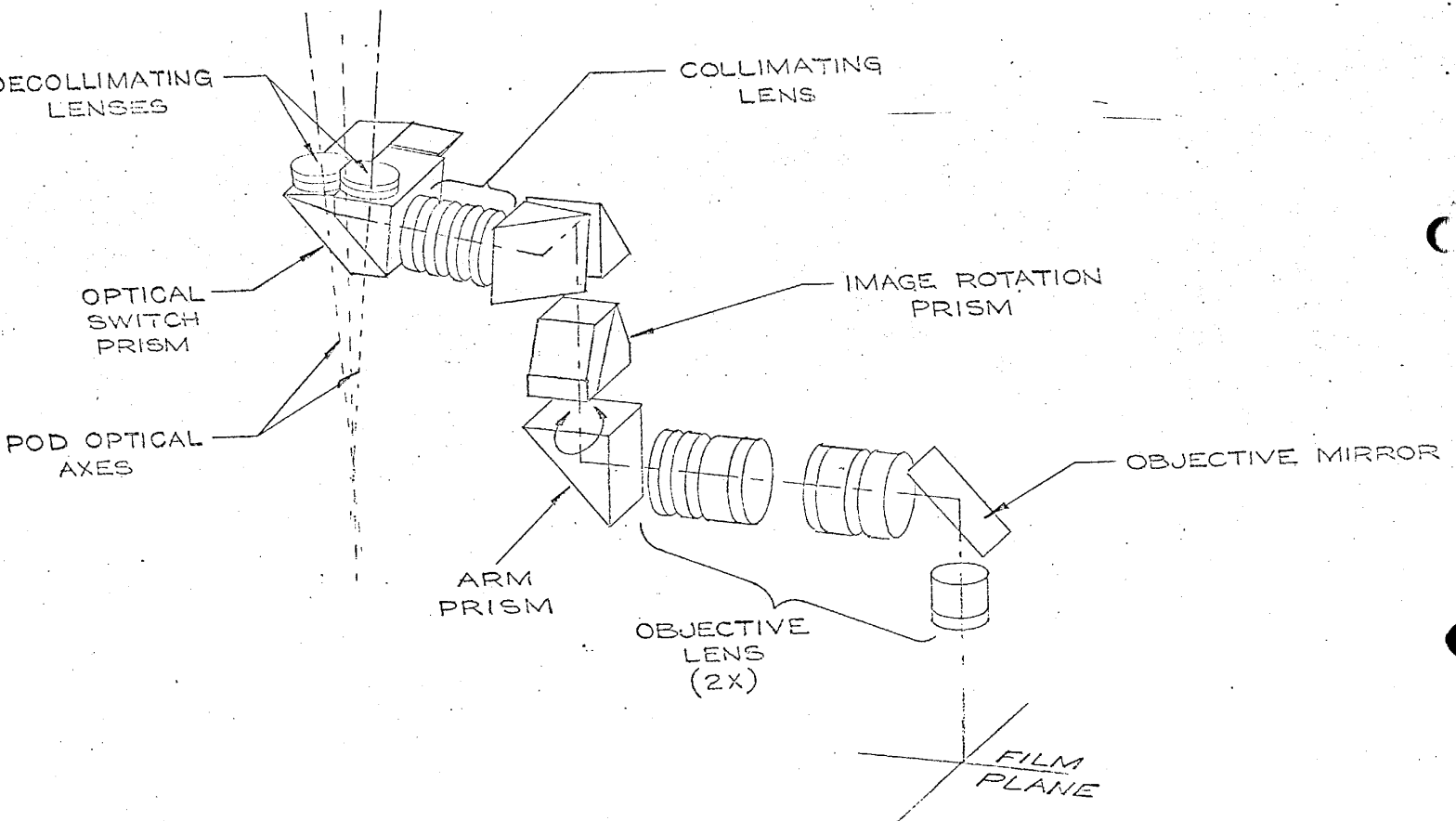
3.0 SYSTEM ANALYSIS

Section 3.0 contains a description of the problems encountered during the alignment of the prototype Advanced Stereo Rhomboid and the effect on the instrument performance. The rework required to correct these problems is described in Section 4.0. See Figure 1 for location of optical components.

3.1 Optical Switch

3.1.1 A beam divider is required in the optical switch to permit mono-viewing. The beam divider coating on the present optical switch prisms acts as a dichroic coating. That is, the spectral distribution of the reflected and transmitted beam are not identical. The reflected beam is yellowish and the transmitted beam is bluish. The result is that different color is evident in each eyepiece during mono-viewing. In normal production, coatings of this nature are rejected. However, with the prototype Advanced Stereo Rhomboid, only one set of prisms were manufactured which did not permit the normal rejection procedure to be followed.

3.1.2 The optical switch prism, for manufacturing convenience, was coated with the stereo-viewing reflecting surface on one prism and the mono-viewing beam divider on another prism. When the prisms were cemented together, the two coatings were not coplanar, due to wedge in the cement layer. This results in image jump when switching from mono to stereo.



ADVANCED STEREO RHOMBOID
OPTICAL SCHEMATIC
FIGURE 1

The image jump described above results in phoria and image runout (when rotating the image rotation prism) in two of the switch positions when the instrument is aligned to the third position. A compromise alignment was made with the phoria minimized in stereo position. The resulting compromise was not optimum for image quality in any position.

3.2 Optical Switch Mounting

In the present system the optical switch was pre-aligned in a fixture and cemented in its slide mount prior to assembly into the main body. However, it became apparent during alignment, that adjustment of this assembled unit to eliminate normal manufacturing tolerances in the main body casting, was not possible because of interaction between two mono-positions of the switch. It is now apparent that each half of the switch has to be independently aligned while assembled in the main casting to eliminate this interaction.

3.3 Collimating Lens Assembly

Due to the minimum available space, the Advanced Stereo Rhomboid was designed with the collimating lens assembled directly into a bore in the main body casting. It was designed so that close manufacturing tolerances would make this lens perform satisfactorily.

During alignment, it was found that the system image quality was improved when the prisms on either side of the collimating lens were more closely aligned with the established optical axis of the collimating lens. If the lens were in a separate mount, its optical axis would be pre-defined and consequently rotating the cell in assembly would permit more alignment freedom. Also, with the collimating lens mounted directly into the main body casting, the ability to pre-test and align the unit is severely limited.

3.4 Rhomboid Arm Axis Intersection

The manufacturing tolerance for the intersection of the axes of the bores in the rhomboid arms is to be within .002 inch. The left and right arms were inspected and found to be out of intersection by .018 inch and .008 inch respectively. The left arm was rebored to be within the .002 inch tolerance (after the initial assembly and alignment). There was no immediate evidence of effect on image quality. However, when the rest of the system is upgraded, the remaining error in the right arm will be significant, and should, therefore, be corrected.

3.5 Objective Mirror Adjustment

The mirror position in the objective lenses is determined by an accurately machined locating surface for ease of

production manufacturing. However, with the sensitivity to centration that has been exhibited by the objectives, the image quality can be improved by tuning these mirrors.

3.6 Objective Lenses

Two problems common to the 1X, 2X and 3X objective lenses were exhibited. These are sensitivity to centration and flare visible around the bars on a negative resolution target.

The centration of the individual elements can be improved by boring the lens mount to the exact diameter of the lens elements in assembly. This technique is used when necessary on production high quality lenses with much success.

The flare visible around the bars on a negative resolution target is due to spherical aberration. In a lens of this type, (known as the "Double Gauss"), the major contributors to spherical aberration are the thicknesses of the two centrally located cemented doublets. Variations in the central air space produce minor effects. The thicknesses of the two doublets can be controlled in production by matching various elements (to a predetermined chart). This procedure could not be followed on the prototype because only two sets of elements were available. This sensitivity is not always possible to predict, however once the necessity has been established (as in this case) the procedure becomes

25X1 relatively straightforward in production. For example, produces two series of professional motion picture lenses (approximately 15 different lenses) the Baltars and the Super Baltars. These are also of the "Double Gauss" type of lens. Only after actual assembly and testing of prototypes could it be known which focal length lenses would require matching and which could be assembled randomly. It is evident at this time, however, that these doublets in the Advanced Stereo Rhomboid objective must be selected and matched in assembly.

3.6.1 1X Objective

The initial tests on these lenses showed the focal lengths of the assembled lenses to be within 0.35% of nominal (normal tolerances are 1.0%). When tested the lenses resolved considerably less than 228 lines/mm. (The design goal is 240 lines/mm. The nearest block on a sixth-root-of-two resolution target is 228 lines/mm.) Efforts to improve the resolution by rotating elements and varying the central air space met with only limited success. A more detailed examination of the components determined that a buried lens surface (within a cemented doublet) was outside of the manufacturing tolerance. A replacement has been ordered, however the order was cancelled pending decisions based on this proposal.

3.6.2 2X Objective

The initial tests on these lenses showed the focal lengths to be within 0.20% of nominal. Initially the lenses would not resolve 456 lines/mm (design goal 480 lines/mm).

After rotating elements, only one of the 2X objective lenses would resolve 456 lines/mm. Also, by varying the central air space the flare was reduced to an acceptable level. Boring to fit and rotating the elements should upgrade the second objective to an acceptable level.

3.6.3 3X Objective

The initial tests on these lenses showed the focal length to be within 1.0% of nominal. When tested, the lens resolved considerably less than 575 lines/mm (design goal 600 lines/mm).

Excessive flare around the bars on a negative resolution target was also visible. Rotating elements and varying the central air space produced a limited effect. Detailed examination of the objective found an element manufactured out of tolerance. Replacement elements were ordered but have since been stopped subject to the outcome of this report.

4.0 PROPOSED CHANGES

The following changes are recommended to make the prototype instrument satisfactory for evaluation. They are based on experience gained while working on the prototype since the beginning of February 1969.

4.1 Remake the Optical Switch

A new optical switch prism cluster will be manufactured with the following changes. It will be made with closer tolerances on the allowable amount and type of color. The mono-viewing beam divider coating and the stereo-viewing reflection coating will be located on the same surface which will eliminate image jump when switching from stereo to mono viewing.

4.2 Switch Mounting

Redesign of the switch mounting will allow the switch prisms to be independently adjusted while assembled in the instrument.

Mechanically, the changes will consist of relocating the switch way rods, redesigning the carriage to provide an X, Y, Z and θ adjustment of the prism mounts independently and adding a cover plate to the bottom of the housing. The proposed prism adjustment will consist of a compound deflection mount shown in Figure 2. The primary advantages of the deflection mount are inherent stiffness, capability of

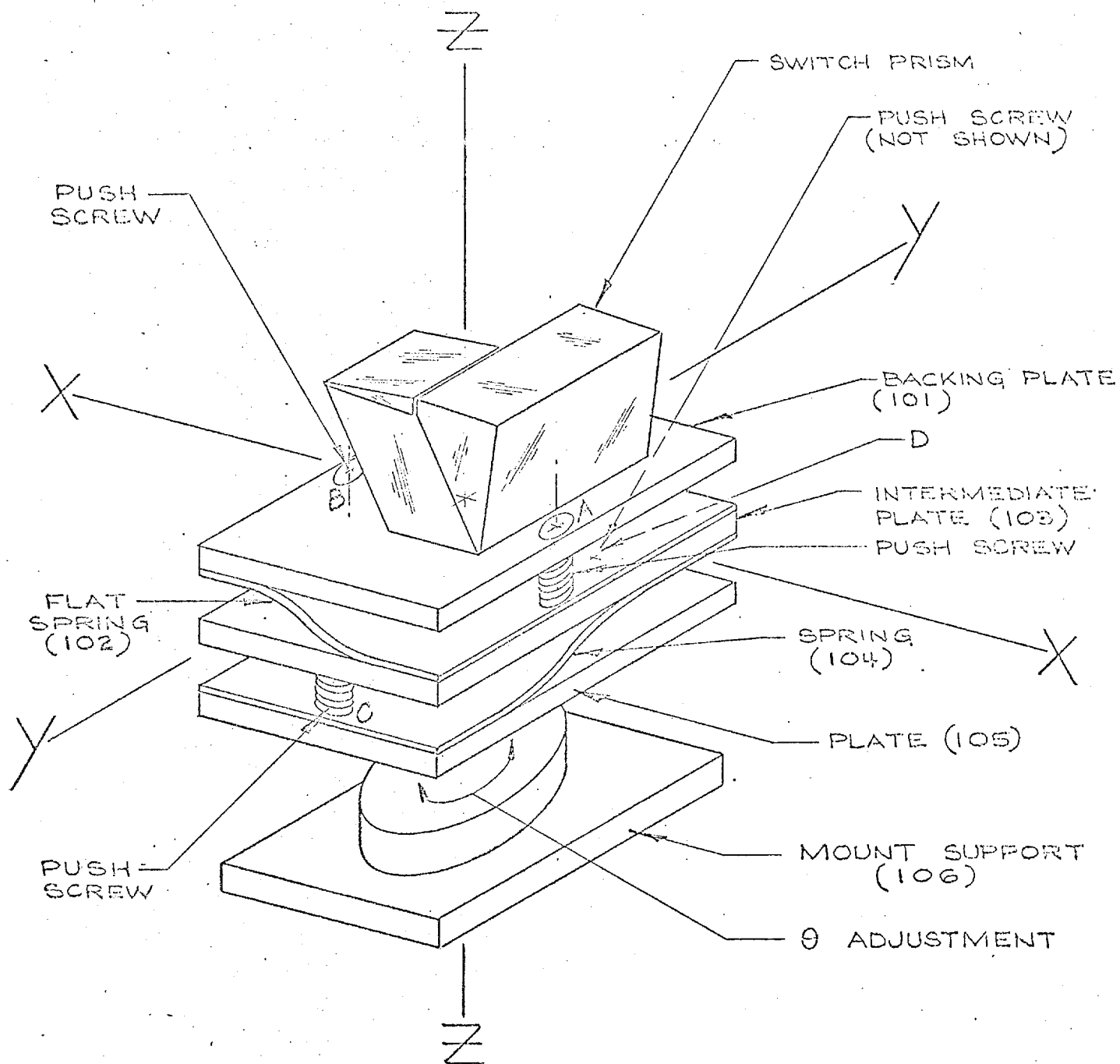


FIGURE 2

SCHEMATIC OF THE PROPOSED
SWITCH PRISM ADJUSTING MOUNT

adjustment on independent axes; and lateral stability superior to a normal push-pull mechanism.

4.3 Remount Collimating Lens

The collimating lenses will be mounted into a separate cell to provide a pre-test capability and greater alignment flexibility. Mechanically, the change can be implemented by boring the present lens mount to a larger diameter and mounting the collimating lenses into a separate thin walled barrel of rather conventional design. The entire cell can then be assembled into the instrument, adjusted rotationally and axially and then locked in place with a set screw arrangement.

4.4 Rebore Arm

One rhomboid arm will be bored to correct the non-intersection of the arm axes. The work will consist of reboring the arms to a larger diameter, inserting sleeves and then remachining the arms using revised fixtures and gaging techniques.

4.5 Remount Objective Mirror

The mirror in the 2X and 3X objective lenses will be made adjustable by locating it against adjusting screws instead of fixed pads. The mirror would then be adjusted and cemented to the pads during final assembly.

4.6 Objective Lenses (No Optical Redesign)

In the Statement of Work there are two options, with and without optical redesign. If the optical redesign alternate is accepted, all the objective elements will have to be remade. This will be described in Section 4.7. If there is no optical redesign, only some of the lens elements and mounts will be remade, as described here.

4.6.1 Remake Doublet Lenses

One cemented doublet in each 1X and one cemented doublet in each 3X objective lens has been found to be out of the manufacturing tolerance. However, because of the necessity for matching doublet thicknesses, one doublet for each objective lens, (including the 2X), will be remade. By careful hand polishing, and checking, it will be possible to match the existing doublets in the present lens assemblies for maximum aberration correction.

4.6.2 Remake Lens Cells

Although the present lens cells are made to precision manufacturing tolerances, it is now evident that the centering of the lenses must be improved to obtain optimum image quality. This will be accomplished by remaking the objective lens cells so that lens bores are sized to match each individual lens diameter. This "bore-to-fit" technique will assure the best attainable alignment of the elements within the mechanical cell.

4.7 Objective Lens (Optical Redesign)

The design data for the objective lenses indicates a small amount of residual aberrations. Recent advances in optical design techniques have produced methods of minimizing the residual aberrations. Visually the effect would be to produce a "cleaner" appearing image and make the bars on a positive resolution target blacker. If the second option in the Section 5 is accepted, the objective lenses on the Advanced Stereo Rhomboid will be redesigned using this new technique. As soon as the design is completed to the point where the effect on image quality can be predicted, the design will be reviewed. A decision will then be made as to whether or not to incorporate the redesign into the Advanced Stereo Rhomboid Prototype.

4.7.1 Optical Redesign

The proposed redesign may result in adding elements in the large central air space. However, the entire lens design will have to be optimized, therefore, all the other elements will probably change (i.e. radii, thickness, etc.). The design effort will be biased where possible to keep the number of elements that have to be changed to a minimum.

4.7.2 Manufacture Objectives

These new elements will be manufactured to close tolerances using the experience for matching gained on the previous prototype.

5.0 STATEMENT OF WORK

Following are statements of work for two options. The numbers in parenthesis after each item refers to the paragraph in the proposal [] which describes the changes to the original prototype Advanced Stereo Rhomboid.

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5.1 Alternate A (No Optical Redesign)

Upon receipt of authorization to spend additional time and funds [] will:

- a. Manufacture a pair of optical switch prisms (4.1).
- b. Redesign the main body casting to include adjustment of the optical switch (4.2).
- c. Redesign collimating lens assembly (4.3).
- d. Remake and modify parts etc. to incorporate items b and c in the main body casting.
- e. Rebore arm to correct Rhomboid Arm axes intersection error (4.4).
- f. Redesign and modify the objective arms to include mirror adjustment (4.5).
- g. Manufacture doublet lenses for 1X, 2X and 3X objective lenses (4.6.1).

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- h. Manufacture objective mounts, boring to fit the lens elements, etc. (4.6.2).
- i. Assemble and align the Advanced Stereo Rhomboid.
- j. Inspect, test evaluate and deliver one prototype Advanced Stereo Rhomboid.
- k. Prepare and deliver operators reference manual.
- l. Prepare and deliver monthly progress reports.
- m. Prepare and deliver a final report.

5.2 Alternate B (Including Optical Redesign)

Upon receipt of authorization to spend additional time and funds, will:

- a. Perform the work listed in Alternate A, through Step f.
- b. Perform optical redesign of the 1X, 2X and 3X objective (4.7.1).
- c. Submit a report containing the results of the optical redesign for evaluation. This report will be used to determine whether or not to proceed with complete remanufacture of the objectives, or to proceed with step g, Alternate A.
- d. Manufacture optical elements according to either (4.6.1) or (4.7.2).

- e. Perform the work listed in steps h through m. in
Alternate A.

The proposed effort is based on an extremely tight schedule for the purpose of minimizing necessary costs and calendar time. Therefore, a delay of more than one week following submission of optical design report Alternate B Item c before proceeding with Alternate B Item d will incur additional costs and extend delivery.

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May 23, 1969

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Attention: [REDACTED]

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Subject: Advanced Stereo Rhomboid

Reference: Contract [REDACTED]

Gentlemen:

As discussed in our meeting May 8 and May 9, there are a number of alternate approaches to the solution of the problems that exist in the present prototype of the Advanced Stereo Rhomboid. Of the five (5) options that were discussed, numbers 4 and 5 were to be further evaluated.

Our cost proposal and statement of work is herein submitted for your evaluation. A detailed discussion listing the current problem areas and proposed solutions is being prepared and will be supplied by May 28. This discussion will include detailed schedules and a discussion relating "probability of success" for each option.

Option "A" and Option "B" correspond to #4 and 5 respectively. In accordance with your request, Option B is split into two separate proposals to provide the opportunity for analysis of new design data prior to the manufacture of the new elements.

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Work has effectively stopped on this program pending further authorization. In full appreciation of the Limitation of Costs articles associated with this contract, [REDACTED] did continue efforts beyond allocated funding. To date, costs are [REDACTED] in excess of authorized funding. This amount should be added to the costs of either option selected for further effort in this program.

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We are extremely anxious to resume work on this program. If you have any questions concerning our proposal, please contact the writer directly.

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Encl. Cost Analysis
Statement of Work

Photogrammetric & Military Systems

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5.0 STATEMENT OF WORK

Following are statements of work for two options. The numbers in parenthesis after each item refers to the paragraph in the proposal [] which describes the changes to the original prototype Advanced Stereo Rhomboid.

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5.1 Alternate A (No Optical Redesign)

Upon receipt of authorization to spend additional time and funds [] will:

- a. Manufacture a pair of optical switch prisms (4.1).
- b. Redesign the main body casting to include adjustment of the optical switch (4.2).
- c. Redesign collimating lens assembly (4.3).
- d. Remake and modify parts etc. to incorporate items b and c in the main body casting.
- e. Rebore arm to correct Rhomboid Arm axes intersection error (4.4).
- f. Redesign and modify the objective arms to include mirror adjustment (4.5).
- g. Manufacture doublet lenses for 1X, 2X and 3X objective lenses (4.6.1).

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- h. Manufacture objective mounts, boring to fit the lens elements, etc. (4.6.2).
- i. Assemble and align the Advanced Stereo Rhomboid.
- j. Inspect, test evaluate and deliver one prototype Advanced Stereo Rhomboid.
- k. Prepare and deliver operators reference manual.
- l. Prepare and deliver monthly progress reports.
- m. Prepare and deliver a final report.

5.2 Alternate B (Including Optical Redesign)

Upon receipt of authorization to spend additional time and funds, will:

- a. Perform the work listed in Alternate A.
- b. Perform optical redesign of the 1X, 2X and 3X objectives (4.7.1).
- c. Submit a report containing the results of the optical redesign for evaluation.
- d. Manufacture optical elements (4.7.2) and mechanical parts (4.6.2) to incorporate redesign of objectives into the instrument.

The proposed effort is based on an extremely tight schedule for the purpose of minimizing necessary costs and calendar time. Therefore, a delay of more than one week following submission of optical design report Alternate B Item c before proceeding with Alternate B Item d will incur additional costs and extend delivery.